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The influence of climatic variables on vegetation response during the growing season – Using Decision Trees (CART) and Multiple Linear Regression (MLR) to define how precipitation, temperature, and solar radiation shape vegetation response globally.

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As future changes in climate announce an increase in the frequency of drier periods, it is important to understand how climatic variables can influence vegetation productivity. An analysis in the growing season is especially relevant, as it is the period when vegetation is most sensitive to climate change. In this study, the NDVI and SPEI were used to represent vegetation productivity and climate variables, respectively, at a global scale, in different temporal scales. The growing season variable was defined as a function of vegetation productivity. Pearson correlation between both variables at different timescales was carried in Google Earth Engine, with a total of 72 scenarios: 3 different NDVI scales *vs* 24 different SPEI scales. An optimal scenario was defined for each pixel, representing the NDVI *vs* SPEI timescale where the correlation was higher. Aiming to understand the importance of different climatic variables on vegetation productivity a CART model was run. Temperature (T), precipitation (P) and solar radiation (Swd) were used as independent variables while optimal Pearson's R was the dependent variable of the model. Additionally, to further detail how the climatic variables were spatially distributed, a multiple linear regression between optimal values of vegetation health (NDVI) and optimal climatic variables (T, P, Swd) was run in each pixel of the map.

The optimal NDVI timescale found for most of the globe was of 5 months, with exceptions in northern latitudes (optimal NDVI: 1 month) and in some arid regions of the globe (optimal NDVI: 3 months). The optimal SPEI timescale exhibits little variation, with optimal timescales between 9 and 12 months for most pixels. CART results showed that locations of low precipitation (<800mm/years) and high solar radiation (net radiation>97 W/m^2) were the locations with the best correlations between climate and vegetation productivity during the growth season, with branches of the model averaging a Pearson correlation above 0.5. The pixel-by-pixel multiple linear regression indicated that precipitation is the controlling factor of vegetation in arid regions, such as Australia, southern Africa and the Mojave and Sonoran deserts. Vegetation in northern latitudes and regions of temperate climate, i.e., Patagonia and temperate prairies in the US, tended to have

radiation as its limiting climate factor. Whilst temperature was the driving factor in wetlands, such as the Pantanal in South America and parts of Southern China and Vietnam. Finally, vegetation in tropical forests and temperate forests showed none of the three climatic factors analysed controlling more than 20% of vegetation response, potentially indicating the dominance of secondary factors.